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JAPANESE INDUSTRIAL POLICY WITH A TWIST: COMMERCIAL AIRCRAFT

Summary

Many Americans, awed by Japan's international success in a growing list of high-technology industries, automatically assume that when Japanese companies start playing catch-up in a particular industry, the U.S. competition is doomed. Concern might be warranted in industries like semiconductors or computers; it is not in commercial aircraft. Japanese aircraft manufacturers lack the range of skills needed to independently design, develop, manufacture and market commercial airliners and high-thrust jet engines. More important, even if aircraft makers and the government were willing to spend the money to close the technology gap, the Japanese market is too small to support a full-fledged domestic industry. These problems dictate the aircraft industry's current strategy of learning the airframe and engine businesses through collaboration with foreign builders. The experience and technology gained from participation in international joint ventures will not be used to mount an independent challenge to American and European aerospace companies, Japanese aircraft executives insist. Their goal, they say, is to become a genuine partner in the international consortia that are an increasingly prominent feature of the world aircraft business.

International partnerships are marriages of necessity for Western aircraft manufacturers. Launching a new plane or engine today is such a high-stakes gamble that no company -- not even the technically and financially formidable Boeing Co. -- feels that it can afford to shoulder the risk alone. U.S. makers, in particular, recognize that they might be helping to create future competitors by including Japanese aircraft companies in their projects, but this is a chance they are willing to take to spread the risks of bringing new products to the market. Western aircraft builders can also justify their decisions to go the joint-venture route with Japanese firms by arguing, as many industry analysts do,

that neither the world airframe market nor the international engine business is large enough to profitably support the three current contenders in each, let alone a Japanese challenger.

Aircraft: Opportunities and Obstacles

Development of an internationally competitive civil aircraft industry anchored on commercial jetliners has been a top objective of Japanese industrial policy for the past 20 years or so. It is not hard to see why. Aircraft research and development provide a seedbed for new processes and products applicable in a wide range of other fields, while the industry's technical requirements stimulate innovation in an equally diverse number of sectors. Airplanes also fit the profile of industries the government believes are crucial to Japan's future economic health because they have a high value-added content — twice that of cars or steel, for example. Another attraction is that expanding world passenger traffic should continue to provide aircraft manufacturers with a growing volume of orders, both for additional transports and replacement equipment. Moreover, commercial jetliners are one product where Japanese manufacturers would be insulated for the foreseeable future from the competition of newly industrialized countries. A developed domestic industry would, in addition, cut the big trade deficit Japan runs each year in aircraft, while using few natural resources and generating little pollution. Finally, the intangible factor of national prestige has attracted Japanese industrial policymakers to the commerical aircraft industry.

These attractions initially blinded Ministry of International Trade and Industry (MITI) officials to the realities of the international market for large jet transports. During the 1960s and the first years of the next decade, economic planners were convinced that aircraft could become a pillar of Japan's industrial structure in the 1970s with government guidance and financial assistance. The results of the YS-11 program over the same period shook this conviction, however. This twin-engine turboprop, designed to carry 52 to 60 passengers on short routes, was a technical success but a commercial failure. With only 182 planes coming off the assembly line by the end of 1973, the government, which had financed half of the cost of the YS-11's development and production, reportedly recouped just part of its investment. (For information on the YS-11 program and the postwar history of Japan's civil aircraft industry, see Council Report No. 2, January 11, 1980.)

While shaken by the failure of Japan's first foray into the world market for commercial aircraft, MITI did not abandon its goals for the industry. It did, however, push back the timetable for development of a full-fledged domestic industry until the 1980s. More important, the YS-11 experience triggered two major shifts in government policy toward the civil aircraft industry. On the financial-support side, policymakers decided that the government would limit its funding to research and development, leaving the risks of production and marketing to the manufacturers. They also concluded that development of a domestic capability in the design, development, production and sale of commercial jetliners hinged on the participation of airframe and engine makers in international joint ventures — a departure in Japanese industrial policy that sets aircraft apart from other high-technology industries singled out for attention by the government.

MITI's more realistic evaluation of the chances of the Japanese aircraft industry becoming internationally competitive on its own in large jet transports has been matched lately by a new appreciation of how long it will take domestic manufacturers to catch

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up with their competitors in the United States and Europe, even with help. Instead of talking about this decade or the next one, the ministry is now looking to 2010 as the target year for a world-class civil aircraft industry. Its overly optimistic 1975 prediction of an 11-percent Japanese share of the free world civilian aircraft market by 1980 has also been discarded, replaced by a more credible projection of a 10-percent slice of international sales around the turn of the century.

These new scenarios reflect a belated admission of the enormous roadblocks in the path of Japanese aircraft builders. To start with, the industry has limited capability to independently design and develop jetliner airframes and high-thrust aircraft engines. A shortage of experienced engineers and inadequate aerospace research and test facilities account for part of this problem. There is, in addition, little technological spinoff from military production since Japan's five fuselage makers and its three engine manufacturers are engaged in licensed production, not development work. (For a discussion of Japan's military production programs, see JEI Report No. 19A, May 14, 1982.) Japanese contenders in the large jet transport field also come up short on manufacturing skills, largely because limited production runs of military hardware, the industry's predominant output, restrict the transfer of these techniques to the civilian side of the business. Moreover, the industry is inexperienced in international marketing and after-sales service.

With time and help from foreign aircraft manufacturers, the barrier to international competitiveness created by inexperience might be overcome. The same cannot be said for the obstacle presented by a domestic market too small to support a Japanese aircraft industry. Japanese airlines carry only about 5 percent of the world's passenger traffic; carriers based in the United States, in contrast, account for roughly 35 percent, using a fleet of planes approximately ten times larger than Japan's. Consequently, Japanese aircraft builders, unlike other manufacturers of technology-intensive products, do not have a strong home sales base from which to launch an overseas marketing effort. Conversely, protection behind trade barriers has never been viewed by the government as a viable strategy for promoting the development of the industry.

Inexperience and a small domestic market are not the only obstacles impeding the progress of Japan's commercial aircraft industry. Any new entrant in the field of large transports faces formidable competition from Boeing Co., McDonnell Douglas Corp. and Airbus Industrie S.A., the European government-supported aircraft development, manufacturing and marketing consortium. Competition is no less intense in jet engines, with United Technologies Corp.'s Pratt & Whitney aircraft division, General Electric Co. and state-owned Rolls-Royce Ltd. fighting it out for market share.

The high-risk nature of the jetliner business is also a major deterrent, since the lessons Japanese aircraft makers learned firsthand with the YS-11 have been reinforced by the recent track records of foreign builders. Lockheed Corp. has abandoned the commercial aircraft market with the failure of its L-1011 TriStar. McDonnell Douglas, which makes the big-selling DC-9, has lost money for the past five years on commercial airliner sales, mainly due to problems with the now-discontinued DC-10. Airbus Industrie is only able to survive in the commercial aircraft business because the participating governments are willing to cover its reportedly huge losses. Even Boeing, the world's most efficient aircraft builder, has seen its profits shrivel up the past two years.

Coming up with the enormous amounts of money needed to launch a new jetliner airframe or engine is a big stumbling block for Japan's industry as well. The bill for designing, developing, testing and certifying a new airframe is generally pegged around $1.5 billion, while getting the plane into full production costs another $1.5 billion or so. The price tag for bringing a high-thrust engine to the market is equally stiff — roughly

$1.5 billion. With the Japanese government only willing to underwrite research and development and then just part of these costs, Japanese aircraft manufacturers maintain that they do not have access to the funds required for a solo entrance into the large transport business.

These problems have capped Japan's aircraft production at a modest level and steered it toward military equipment (see Tables 1-3). Production of aircraft, engines, subassemblies, parts and related accessories totaled under $1.5 billion in 1982. While repair work added roughly $0.3 billion to this figure, the combined total represented just 4.2 percent of U.S. shipments — in fact, a slightly lower ratio than five years before. Moreover, 75.9 percent of Japan's 1982 output consisted of hardware manufactured for the Defense Agency, although the military share was ten points lower than in 1978.

For individual Japanese companies, the aircraft business remains a side line. Mitsubishi Heavy Industries, Ltd., the top producer, had aircraft sales of just $789.2 million in FY 1982, and number-two Kawasaki Heavy Industries, Ltd. generated only $401.4 million in aircraft revenues over the same period. Boeing, in contrast, had sales of $9 billion in 1982. With the start of full-scale licensed production of F-15 fighters and P3C antisubmarine patrol planes, however, aircraft are becoming an increasingly important sales earner for Japanese manufacturers. At Mitsubishi, the prime contractor for the F-15, aircraft contributed 12 percent of sales in FY 1982 versus 9.4 percent the year before, while Kawasaki, the major P3C contractor, saw its aircraft sales climb from 7.1 percent of the total to 14.5 percent.

Learning the Airframe Business

While MITI and the aircraft companies have recognized for at least the past decade that significant growth on the commercial transport side of Japan's aircraft business is tied closely to the participation of domestic manufacturers in international joint ventures, this strategy is just starting to pay dividends in terms of increased production. The joint-venture route was first explored in the early 1970s. At that time, the government and the industry realized that their initial plans for a YS-11 follow-up project, codenamed the YX project, had been overtaken by the advent of wide-body airliners. Project specifications were revamped from a small (90-passenger), local transport to a twin-engine, wide-body, medium-range jetliner, even though designers were aware that such a plane was beyond the capability of Japan's industry, both technically and financially. The hoped-for solution was to develop and build the YX in collaboration with American or European aircraft manufacturers. Boeing, McDonnell Douglas and Lockheed all made proposals, but they did not get off the ground, largely because the Japanese government offered to finance only a fraction of the YX's estimated ¥100-billion ($416.7 million at ¥240=$1) development costs.

The YX project languished until the fall of 1977 when Boeing agreed to work with Mitsubishi, Kawasaki and Fuji Heavy Industries, Ltd. — grouped into the Civil Transport Development Corp. (CTDC) — as well as Aeritalia S.p.A. — an Italian aerospace consortium — on the development and production of the 767, a twin-engine, wide-body, medium-range airliner seating 211 to 220 passengers. The Japanese team, along with its Italian counterpart, has a status in between equity partner and subcontractor on the 767 project, Boeing's first program with non-American risk-sharing participants. The CTDC did not share full development costs; neither was it involved in preliminary design and development work or in marketing and sales of the technically advanced 767, which entered commercial service in September 1982. On the other hand, the Japanese trio is guaranteed work, at an agreed price, on the first 500 planes produced.

The three Japanese participants are responsible for the 767's body sections and wing fairings. Mitsubishi builds the aft fuselage panels and entry, service and cargo doors, while Kawasaki produces the forward and center fuselage panels as well as the wing ribs; Fuji makes the wing-to-body fairings and the main landing-gear doors. Together, these subassemblies represent about 15 percent of the 767's airframe costs, as do the parts being built by the Italian consortium, which include much of the tail, the wing leading edge and some control surfaces. On the basis of total project costs, including engines, electronics and accessories, the contribution of the Japanese and Italian participants drops to roughly 7 percent each.

Total Japanese development costs for the 767 are estimated at ¥32 to ¥34 billion ($133.3 to $141.7 million at ¥240=$1) over the five years through March 1983. Of this amount, the government put up ¥14,652 million ($61.1 million) in the form of a hojokin or success-conditional loan. U.S. policymakers consider loans such as this one to be subsidies on the grounds that no high-technology industry in Japan has ever repaid this type of R&D funding. Their assessment might have to change, however, since Mitsubishi, Kawasaki and Fuji paid back ¥3,870 million ($16.1 million) of the principal this past spring, using money from the proceeds of the sale of subassemblies for five 767s to Boeing.

How much have the Japanese participants learned about the large transport airframe business for their development money and the additional ¥20 billion or so ($83.3 million) spent on facilities and tooling to produce 767 subassemblies? They have certainly gained added experience in the design and development of fuselages, thanks to Boeing's considerable input, and their manufacturing skills in at least this area of the airframe have been honed. Most industry watchers, though, characterize these gains as incremental increases in knowledge and ability, pointing out that the 767 sections made by the Japanese side do not involve particularly sophisticated design or production technologies.

While the benefits to Japanese airframe makers might be limited, this has not stopped some analysts from wondering whether Boeing is giving a future competitor a big helping hand in exchange for less risk exposure. This question is likely to come up again — and more loudly than before — because the aerospace giant and the Japan Aircraft Development Corp., the CTDC's successor, are fairly close to signing a memorandum of understanding for a fuel-efficient, quiet plane in the 150-seat range, designated the 7-7 by Boeing and the YXX by Japan.

MITI and the aircraft industry started discussing the YXX project with potential foreign partners in 1980. Proposals from McDonnell Douglas and Airbus Industrie as well as Boeing were considered. It is generally assumed that the Seattle firm had the inside track from the beginning, but the talks have dragged on. One holdup has been contract terms. The Japanese side wants to be a full-fledged partner in the project, involved in all phases from design to marketing, not just a risk-sharing participant. Boeing is apparently amenable. In exchange, though, it reportedly asked Mitsubishi, Kawasaki and Fuji to cover 30 percent of the estimated $1.5-billion cost of designing, developing, testing and certifying a new 150-seat airliner. The Japanese trio initially balked at this request, but later proposed a 25-percent share, to be split, it appears, with at least one other company, probably Nissan Motor Co., Ltd. This offer is thought to be acceptable to Boeing, which is still talking to other foreign makers like Aeritalia about participation in the 7-7 program.

Boeing is in no rush to move ahead with the 7-7 project. The huge launch costs of the 767 and 757 (an all-new twin-engine, standard-body jet designed to carry 178 to 186 passengers on medium-to-short routes) have been a big financial drain on the company, which has firm orders now for only 185 767s (including 34 from Japan's

international carrier and its main domestic airline) and 129 757s. Development of a stretched version of the 737 short-haul airliner, scheduled for rollout next January, and the introduction earlier this year of a new jumbo 747 model have also added to Boeing's negative cash flow.

For that matter, neither are Boeing's potential Japanese partners in a hurry to start work on a new airframe. They, too, are short of funds. Slow demand for the 767 has kept production of subassemblies far below initially anticipated levels. Moreover, the companies are only now starting to recoup some of the money spent to get the F-15 and the P3C into production.

The delays are not expected to put the Boeing-Japanese team at a big competitive disadvantage with Airbus Industrie, the only airframe builder close to bringing out a 150-seat transport, because the airlines do not have the money to buy new planes from any manufacturer. (The 120 members of the International Air Transport Association had a combined operating loss of $3.1 billion over the 1980-82 period, with American carriers alone losing $1.3 billion during this time.) Moreover, with fuel prices dropping in 1982 and again this year, the airlines have less incentive to sign up for the next generation of fuel-efficient planes. Instead, they are sticking with their present fleets, making improvements like fitting new engines to save fuel, or tapping the large supply of good used aircraft.

While waiting for the market to firm for a quiet, efficient 150-passenger plane, Boeing is pushing ahead with initial design work. The Japan Aircraft Development consortium is also doing some independent design studies, supported by ¥4,088 million ($17 million at ¥240=$1) in loans from the government since FY 1981. There is no indication of how much more development money the government is willing to spend for the YXX project. Japanese aircraft manufacturers want MITI to be more generous than it was on the YX program since they will be shouldering larger risks. Some sources report, though, that the ministry will only underwrite that part of the YXX development work new to the Japanese participants.

Gaining Experience in Engines

Uncertainties surrounding the development of a new, high-efficiency turbofan jet engine for a 150-passenger airliner are also holding up the 7-7 program as well as Airbus Industrie's proposed A-320. Back in 1980, a joint venture between Japan's trio of aircraft engine manufacturers — Ishikawajima-Harima Heavy Industries, Ltd. (IHI), Kawasaki and Mitsubishi — and Rolls-Royce had hoped to be the leading candidate to supply the engine for the next generation of short-range transports. At that time, Rolls-Royce and the Japanese Aero Engines Corp. began development work on an engine for a 130-seat plane, using as their starting point the technology gained from Japan's FJR 710 fanjet program, an 11-year (FY 1971-FY 1981), ¥19.8-billion ($82.4 million at ¥240=$1) project funded entirely by the government under the National Research and Development Program (see JEI Report No. 42, November 6, 1981).

By early 1982 the consortium had two demonstration models of the 20,000-pound-thrust RJ 500 turbofan engine ready for testing. In the interim, though, airlines began to push for a plane in the 150-seat range, which requires an engine with a thrust of about 23,000 pounds. Redesigning the RJ 500 for a bigger plane would have at least doubled the British-Japanese project's development costs, initially estimated at ¥140 billion ($585.3 million). Neither Rolls-Royce nor the three Japanese manufacturers were willing to increase their financial exposure to this extent. Moreover, MITI, which had lent the Japanese team ¥10 billion ($41.6 million) for development work during the FY 1980-FY 1982 period and had earmarked another ¥4.7 billion ($19.6 million) for development loans in the FY 1983 budget, apparently had reservations about the project's greater risks.

With the Japanese trio's support, Rolls-Royce sought out a third partner for their venture. Both Pratt & Whitney and General Electric vied for the spot; Pratt & Whitney won it. The reason why the world's number-one engine maker was willing to set aside traditional rivalries and collaborate with third-ranking Rolls-Royce and the Japanese is not hard to find — it cannot afford to proceed independently with a 150-seat-plane engine. The company is just finishing up development and certification tests for the PW 2037 engine, an all-new, 37,600-pound-thrust powerplant for the Boeing 757. Earlier, it modified its family of JT9D engines for the 767, while late last year plans were announced for the PW 4000 series of 48,000-to-60,000-pound-thrust engines.

After jockeying over questions like design specifications, work assignments and financial shares, Pratt & Whitney and Rolls-Royce announced plans this past March for a five-nation project to design, develop, produce and market a 23,000-pound-thrust engine. The final arrangement, signed in mid-September, calls for Pratt & Whitney to head one team of companies, including Motoren und Turbinen Union Munchen G.m.b.H. of West Germany and Fiat Aviazione S.p.A. of Italy, both of which were risk-sharing partners (11 percent and 4 percent, respectively) in the PW 2037 program. Rolls-Royce will lead the other group, made up of its three Japanese partners on the RJ 500 project. The two team leaders will each underwrite 30 percent of the total development costs, generally pegged by industry analysts at $1.5 billion-plus, while the Japanese trio will put up 23 percent.

The five-nation consortium must win government approval, particularly in the United States and the United Kingdom, before it can start design work on the new engine, which is expected to incorporate features of the PW 2037 and the RJ 500 and to be certified for commercial service in 1988. One of the questions the U.S. Department of Justice must resolve is whether the joint venture reduces worldwide competition in jet engines. Pratt & Whitney executives maintain that the project will increase competition since right now only one other group, headed by General Electric, has plans to develop an engine for a 150-seat plane. Approval in the United States also reportedly hinges on the amount of technology transfer in the project. Spokesmen for Pratt & Whitney have been quoted as saying that the collaboration has been structured in such a way that no technology will have to be exported. The Pratt & Whitney team will work on the turbine and combustor portions, while Rolls-Royce and the Japanese group will develop the engine's front end, including the fan and the compressors.

Justice Department approval is expected, possibly this year, but the agency, which has been looking at the project for the past year and a half, has not tipped its hand. If Pratt & Whitney's participation is turned down, there is no guarantee that Rolls-Royce and its Japanese partners will go ahead with development of an engine for a 150-seat plane. MITI is reportedly willing to finance (presumably through loans) half of the development costs to be covered by the Japanese participants in the five-nation project — an amount estimated at $143 million. It is unlikely to go beyond this figure, having already spent a similar amount on jet-engine development work. This would doom the chances for continuation of an independent British-Japanese project, since IHI, Kawasaki and Mitsubishi say they cannot afford a larger share of development costs and the British government is not anxious to finance loss-plagued Rolls-Royce in the high-thrust end of the market.

Partner or Rival?

Are Western airframe manufacturers and aircraft engine makers helping to create their future competition by tying up with Japanese companies in international joint ventures? Mitsubishi and other Japanese builders maintain that their objective is limited

to gaining the experience and technical capability to be partners in all aspects of the airframe and engine business, from design and development through marketing and after-sales service. MITI industrial policymakers might have more ambitious ideas in mind for the Japanese industry, company officials admit, but budget constraints hamper the ministry's ability to translate its "visions" into reality.

American and European aerospace executives do not discount the possibility that their strategy might backfire, but they are fairly confident that the Japanese aircraft industry is, in fact, more interested in being a long-term partner than a future competitor. Even if they are wrong about Japan's intentions, add these officials, American and European aircraft makers have at least 20 years of breathing room. In the meantime, the Japanese industry's interest in learning the airframe and engine business and the need for Western builders to spread the risks of their enormous investments make international partnerships the only viable option.

For further information, contact Susan MacKnight.

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Table 1A: Aircraft Production in Japan, 1978-82

(in thousands of dollars*)

Year	Total	Customer			
		Defense Agency	U.S. Military	Domestic Market	Export Market
1978	$1,074,325	$928,232	$0	$100,822	$ 45,271
1979	984,467	842,247	0	83,673	58,547
1980	928,829	758,703	4	90,311	79,810
1981	1,037,227	790,451	0	84,629	162,147
1982	1,484,883	1,127,155	0	119,145	238,583

Table 1B: Aircraft Repair in Japan, 1978-82

(in thousands of dollars*)

Year	Total	Customer			
		Defense Agency	U.S. Military	Domestic Market	Export Market
1978	$215,005	$176,122	$6,388	$31,502	$ 993
1979	242,274	194,519	6,411	40,490	853
1980	235,568	186,509	7,916	39,352	1,791
1981	251,582	201,791	9,976	37,612	2,204
1982	272,809	209,645	8,500	52,921	1,743

*The following average annual exchange rates, which reflect the midpoint on the Tokyo spot foreign exchange market, were used to convert the yen production figures: 1978, ¥210.40; 1979, ¥219.14; 1980, ¥226.75; 1981, ¥220.54; and 1982, ¥249.05.

Source: Japan, Ministry of International Trade and Industry, Yearbook of Machinery Statistics 1982

Table 2A: Aircraft Production by Product in Japan, 1982

(in thousands of dollars)

	Total	Customer		
		Defense Agency	Domestic Market	Export Market
Aircraft	$434,917	$380,486	$ 0	$ 54,431
Fixed-Wing Planes	374,595	337,105	0	37,490
Piston-Engine Planes	1,522	1,522	0	0
Turbojet Planes	286,143	253,865	0	32,279
Turboprop Planes	86,930	81,719	0	5,212
Helicopters	51,841	34,901	0	16,940
Other Aircraft	8,480	8,480	0	0
Airframe Parts and Equipment	542,678	335,443	57,531	149,705
Engines and Parts	303,345	272,564	26,802	3,979
Engines	185,501	181,164	4,288	48
Piston Engines	0	0	0	0
Turbojet Engines	162,638	162,574	64	0
Turboprop Engines	12,728	12,728	0	0
Turboshaft Engines	7,300	5,730	1,570	0
Other Engines	2,835	133	2,654	48
Engine Parts	117,844	91,399	22,514	3,931
Propellers and Rotors	8,031	8,010	20	0
Accessories	62,373	48,781	7,749	5,842
Instruments	66,481	47,484	17,691	1,305
Training Devices	17,627	16,194	1,433	0
Support Equipment	49,432	18,193	7,918	23,321
Total Production	1,484,883	1,127,155	119,145	238,583

Table 2B: Production of Aircraft and Aircraft Engines in Japan, 1982

(in units)

	Total	Customer		
		Defense Agency	Domestic Market	Export Market
Aircraft	108	56	0	52
Fixed-Wing Planes	86	36	0	50
Piston-Engine Planes	3	3	0	0
Turbojet Planes	61	25	0	36
Turboprop Planes	22	8	0	14
Helicopters	22	20	0	2
Other Aircraft	15	15	0	0
Engines	116	109	7	0
Piston Engines	0	0	0	0
Turbojet Engines	65	64	1	0
Turboprop Engines	21	21	0	0
Turboshaft Engines	27	21	6	0
Other Engines	3	3	0	0

Source: Japan, Ministry of International Trade and Industry, Yearbook of Machinery Statistics 1982